CONSERVATION COMMITTEE REPORT

Falconry: Effects on Raptor Populations and Management in North America

Falconry can be defined as the sport of hunting with trained raptors. Historically, falconry referred to the training and use of falcons in hunting but now the term is used to describe the use of all raptors trained to take prey. Because of recent declines in population levels of some species of raptors such as the American Peregrine Falcon (*Falco peregrinus anatum*), (Hickey 1969, Cade and Fyfe 1970), Cooper's Hawks (*Accipiter cooperii*) (Snyder et al. 1973), and use of falcons in entertainment (i.e. Atlanta Falcons Football Club and Air Force Academy Falcons Sports), concern has been expressed since the early 1960's about both the future of falconry as a sport and its impact on raptor populations. With listing of the American Peregrine Falcon as an endangered species on 8 March 1969 by the U.S. Fish and Wildlife Service, interest in the welfare of most species of raptors increased. Stringent controls and regulations on taking raptors and on the sport of falconry were instigated in many states in the early 1970's. The Supplementing Agreement to the Convention for the Protection of Migratory Birds and Game Mammals with Mexico in 1972, and subsequent drafts of proposed federal falconry permit regulations created controversy and conflict among falconers, environmental groups, state conservation agencies, and the U.S. Fish and Wildlife Service. The Conservation Committee of the Wilson Ornithological Society undertook this review of the sport of falconry, impacts of removing raptors from the wild, and the final form of federal falconry permit regulations (Federal Register 41(10):2237–2240, 41(37):8053) issued in February 1976.

FALCONRY

The earliest records of falconry are from Mongolia and Egypt (about 2000 B.C.) where it probably originated not as an art or sport but as a method to secure food. The use of trained falcons for hunting evolved into an art and sport which reached its peak popularity in the Middle Ages. From the 8th to the 17th century, falconry flourished in Europe where the type of raptor permitted correlated with social class. After the Middle Ages, interest in falconry declined, perhaps because of firearms development and changes in social order (Nye 1966).

Falconry developed slowly in North America, probably because it was not typical of immigrant peoples or appropriate to pioneer life. By the early 1900's, interest slowly increased, stimulated by R. L. Meredith and an article in the *National Geographic Magazine* in 1920 by Louis Agassiz Fuertes (Nye 1966). As the result of efforts by Meredith and others to stimulate interest in falcons and falconry, the art and sport grew such that, by the late 1930's, over 100 falconers were active in the United States. Growth of falconry was slow in the 1940's and 1950's but greatly increased in the 1960's and early 1970's when there were an estimated 1500 active falconers. This can be partially attributed to increased publicity and legalization of the sport. In 1964 the U.S. Fish and Wildlife Service permitted the use of trained raptors in the taking of migratory game birds. A survey of states and Canadian provinces and territories by the Conservation Committee revealed that 6 of 11 provinces and territories responding and 34 of 47 states responding allow falconry. Supported by the federal regulations in 1976, the tradition of taking raptors for falconry and the "sport" have been solidly established by law.

The Environmental Assessment prepared by the U.S. Fish and Wildlife Service (1976) on the proposed federal falconry regulations states that about 2769 falconry permits had been issued by 29 states in 1974 and projects that 5900 falconers will be licensed in 1980 if all 50 states were to allow falconry. This estimated 2-fold increase may be realized because of previously unlicensed falconers applying for licenses, better law enforcement, and increased awareness of the sport.

The Conservation Committee doubts the projected increase will occur. Falconry requires proper facilities, hard-won expertise, long hours, and dedication. We estimate conservatively that fewer than half of the about 2700 permittees presently licensed are active falconers. The remainder keep raptors, perhaps due to the novelty or supposed glamour of the activity. Administration of federal and state regulations on training, experience, facilities, testing, record keeping and restrictions on the species of raptor allowed is such that license applications will not rapidly increase. Indeed, we estimate that the increase may approximate 40% by 1980 or about 5% per year.

STATUS OF RAPTOR POPULATIONS

The Environmental Assessment of the proposed federal falconry regulations lists 18 species of raptors of "importance" to falconry in North America, but only 6 species, including the Red-tailed Hawk (*Buteo jamaicensis*), Goshawk (*Accipiter gentilis*), Harris Hawk (*Parabuteo unicinctus*), American Kestrel (*Falco sparverius*), Prairie Falcon (*F. mexicanus*) and Peregrine Falcon represent most used at the present. Red-tailed Hawks are certainly the most used in North America.

The status of any wildlife population may be evaluated in 3 general ways: (1) complete annual counts, (2) development of an abundance index in some stage of the life cycle, or (3) a life-equation approach which provides an indirect evaluation of the population's condition. These approaches are not new and fall within the general outline presented by Leopold (1933:139).

A complete count of a raptor population is difficult or impossible unless the area is small and few reliable long-term data are available. Indices of abundance based on counts of fall migrants are available but are confounded by weather, numbers of observers, changes in counting sites, etc. We have relied primarily upon the life-equation approach to evaluate the status of selected raptor populations. A *recruitment standard* was estimated for most species discussed based on models. Knowledge of some parameters used in the models may be excellent but others are poorly understood. Nevertheless, recruitment standards, the long-term average production rate per breeding-age female required to maintain a stable population, have been estimated (Henny 1972; Henny and Wight 1972). The number of young fledged per successful nest, based primarily on banding records, provides a long-term index of production but does not reveal, of course, population decline since young are banded only at existing nests. Finally, production rates based on intensive short-term nesting studies were compared with the long-term recruitment standards. The importance of pesticides as a factor in population declines of raptors used in falconry was kept in mind in the review of available data on raptor populations.

Considerable progress has been made in the last decade demonstrating the relationship between population declines of several species of raptors useful for falconry and pesticide contaminants. Soon after Ratcliffe's (1967) initial report of eggshell thinning in British Peregrines and Sparrowhawks (*Accipiter nisus*), similar thinning was discovered in North American Peregrines (Hickey and Anderson 1968), here associated with high levels of DDT and its metabolites, especially DDE. Measurements of the eggs of

many other species of raptors were soon made, and reductions in eggshell thickness were found in several, especially Sharp-shinned Hawks (*Accipiter striatus*), Cooper's Hawks and Prairie Falcons (Anderson and Hickey 1972). Other species important in falconry, such as the Goshawk and Red-tailed Hawk, which feed primarily on mammals, were shown to be much less involved in the shell-thinning problem than species which feed heavily on birds.

Peregrine and Prairie Falcons.—The correlation of DDE in egg contents and thin eggshells has been clearly established for Peregrines (Cade et al. 1971) and Prairie Falcons (Fyfe et al. 1969; Enderson and Wrege 1973). Enderson and Berger (1970) showed that fledging success is inversely correlated with thin-shelled eggs in Prairie Falcons. Despite obvious correlations among DDE residues, eggshell thinning, and reproductive failure in some raptors, it is difficult to establish that these events are in fact the prime cause of population decline of such species as Peregrines (Hickey 1969). A major argument has been that DDT and its metabolites were not abundant enough to account for declines apparent by 1950. Peakall (1974) cleverly demonstrated that DDE was present in amounts accounting for pronounced shell-thinning in Peregrine eggs in California as early as 1948 by extracting residues from shell membranes of museum eggs and comparing the levels with more recent eggs for which the egg contents had also been analyzed.

A major circumstance to be remembered is that pesticide contamination or population declines of Peregrines and Prairie Falcons have not been uniform throughout the range of these species in North America. Prairie Falcons declined 34% in occupancy of territories in western Canada with the reduction being concentrated in 4 of 6 areas studied (Fyfe et al. 1969), but one report (Enderson 1969) and several unpublished accounts from the Rocky Mountain region reveal they are normally abundant and reproducing well. Peregrines disappeared as a breeding bird in the eastern United States, but are not declining and are not significantly contaminated with DDE in the Aleutian Islands (White et al. 1973).

Peregrines in North America, except for those in the Aleutian Islands, are experiencing reproductive difficulties due to DDE, and the threat is probably greater to this species than any other. Even in the Queen Charlotte Islands, British Columbia, Peregrine eggs contain about 3 times the DDE residues found in Aleutian Peregrine eggs (White et al. 1973). Fewer pairs nested in the Queen Charlottes in 1970 than in 1960 (Nelson 1970). Elsewhere in North America, populations are generally declining or steady with some reproductive difficulty apparent. In the Rocky Mountain region from northern New Mexico to Montana, 14 pairs fledged only 3 young in 1973 (Enderson and Craig 1974). In 1974 only 10 of those pairs could be found, but they reproduced well despite thin-shelled eggs. In 1975 only 7 of the original 14 pairs could be found and fledging success was poor. A few pairs are known to persist in western Texas (G. Hunt, pers. comm.) and in California. It is probably true that only between 20 and 30 pairs of Peregrines were known to nest in the contiguous United States in 1975.

American Kestrel.—The status of the American Kestrel in North America was reviewed by Henny (1972). The number of young banded per successful nest in the Northeast provided a crude index to production. The mean number banded per nest was 3.92 young for 1925–45, 3.92 for 1946–59, and 3.63 for 1960–68. The data for the latter period suggest a 7% decrease in young fledged per successful nest. Hackman and Henny (1971) also suggested a slight population decrease in the East. Lincer and Sherburne (1974) found relatively high levels of DDE in the eggs of Kestrels breeding near Ithaca, New York, and felt pesticides were being obtained in the wintering grounds in the southeastern United States.

The Environmental Assessment of the proposed falconry regulations mentions a recent increase in eastern populations, perhaps due to DDT bans. Kestrel eggshells were thinned 10% by one application of DDT at .84 kg per ha on 172,800 ha in the 1974 DDT-Tussock Moth Spray Program in the Pacific Northwest (Henny et al. 1976, unpubl. report). This was accompanied by a 5-fold increase in residue levels of DDT and its metabolites in the eggs over those from controls 30–50 km from the spray area.

Red-tailed Hawk.—The Red-tailed Hawk nests throughout much of North America and few reports of Red-tailed Hawk population declines appear in the literature. Furthermore, Henny and Wight (1972:246) report no significant change in average production per successful nest during the DDT era in North America. They concluded that reproduction is balancing mortality rates in the populations. Unlike other raptors, counts of migrant Red-tailed Hawks at White Marsh, Maryland during the 1950's and early 1960's also remained stable (Hackman and Henny 1971). Anderson and Hickey (1972) found eggshell thinning exceeding 9% in 5 Montana eggs, but other eggshells from the United States were near normal.

In recent years a number of short-term nesting studies of Red-tailed Hawks have been conducted. The observed production rates have approximated the long-term production standard estimated by Henny and Wight (1972). A six-year study (1966–71) in Saskatchewan showed production slightly in excess of that believed required (Harris 1971), while a 3-year study (1967–69) in Alberta showed a population declining slightly (Luttich et al. 1971). Orians and Kuhlman (1956) reported slightly above normal production in Wisconsin in 1953–55, while Gates (1972) reported production slightly below normal in east-central Wisconsin in 1962–64. Similarly, Seidensticker and Reynolds (1971) reported below-normal productivity and 10.9% shell thinning during a 2-year study (1966–67) in south-central Montana. A more recent study (1971–72) in southwestern Montana, however, shows normal production (Johnson 1975). Production in southern California in 1973 appeared to be excellent in an area where man was not interfering with nesting (Wiley 1975). Annual production rates are variable, depending upon local conditions, but the results of the short-term studies in the pesticide era reveal the species is reproducing normally.

Cooper's Hawk.—Accipiters experienced eggshell changes about twice as great as the buteos (Anderson and Hickey 1972) paralleling the reported declines of Cooper's Hawks and Sharp-shinned Hawks in eastern North America (Spofford 1969, Hackman and Henny 1971, Snyder et al. 1973). Young banded per successful nest in the Northeast was taken as a crude index to production (Henny and Wight 1972). The mean number banded was 3.53 young for 1929–45, 3.08 for 1946–48, and 2.67 for 1949–67. More recently, calculations for 1968–74 show an improvement to 3.36 young (Henny, unpublished data). These findings accompany the contention of the Environmental Assessment that Cooper's Hawks have increased in the East during recent years.

PROBLEMS ASSOCIATED WITH MANAGEMENT OF RAPTOR POPULATIONS

Major problems associated with management of raptor populations include contamination of food chains by pesticides, loss of habitats necessary for foraging and nesting, and man-caused mortality (White 1974). Unlike the role of contaminants in declines of some species of raptors, losses of nesting habitat, suitable foraging areas, and prey species are less well documented (White 1974, Braun et al. 1975) but may be important locally. Disturbance of nesting sites by photographers, banders, and the general public can reduce hatching and fledging success (Fyfe and Olendorff 1976). Alteration of nesting sites by nuclear tests has had similar results (Stahlecker and Alldredge 1976). Shooting

increases mortality of raptors despite nearly complete legal protection from this source. With increased awareness of values of raptors and enforcement of regulations, losses of all birds of prey through shooting appear to be low compared to earlier periods. Man-caused mortality by vehicles, electrocution, trapping, poisoning, and egg collecting appears to be low and stable at present although data are lacking for definitive statements. These causes undoubtedly are responsible for some mortality but actual impacts on overall populations are unknown.

The Environmental Assessment of the proposed federal falconry regulations documented little mortality of raptors trapped and transported for purposes of falconry. In a survey of British falconers, Kenward (1974) estimated that from 11 to 53% of raptors taken as nestlings, depending upon species, died in the first year of captivity. The survey further indicated that between 50 and 93% of the trained raptors were eventually lost or released. Similar data are not available for North America but it can be safely assumed that deaths of birds taken as nestlings, especially by inexperienced people, are quite high and may exceed those values reported by Kenward (1974).

Cade (1968) estimated that from 25 to 50% of the annual production of Gyrfalcons (*Falco rusticolus*) in Iceland was exported under strict regulations for falconry each year for several centuries with no noticeable impact upon the breeding population. Blood (1968) reported that removal of about 12 nestling Peregrines annually from 1952 to 1967 from the Queen Charlotte Islands did not appear to adversely affect breeding Peregrine populations. Exploitation rates of raptors for falconry appearing in the Environmental Assessment suggest that less than 0.5% of any species population is taken annually. If first-year mortality rates of most raptors in the wild approximate 40 to 60% (Shor 1970, Luttich et al. 1971) and most raptors taken for falconry are first year birds, it is obvious that removal of raptors from the wild for falconry at even double the present levels could not be responsible for regionwide population declines.

Recently, interest in management of raptors has increased, primarily the result of concern about local populations. Olendorff and Stoddart (1974) give an excellent statement of management possibilities for grassland raptors, including the likely possibility of increasing nesting sites by providing man-made structures. Perhaps the largest and most successful attempt in providing artificial nesting sites was conducted in Michigan in 1967 where 43 nest platforms were constructed for Ospreys (*Pandion haliaetus*). The majority of the platforms became occupied in later years and pairs using them experienced lower nestling mortality than pairs using the dwindling supply of natural sites (Postupalsky and Stackpole 1974). In an area in California, the total number of Osprey nests producing young was increased by 37% over the previous 3 years after artificial nest platforms were erected (Garber et al. 1974). R. Fyfe (pers. comm.) has shown that Prairie Falcons nest readily in holes dug in dirt banks where none existed before.

The most massive effort to restore reduced or extirpated populations is now underway for the Peregrine. There are several options available and all are difficult. Population recovery of Peregrines could be effected by 3 means: (1) reduce DDE contamination through limiting or prohibiting the use of DDT, (2) artificially increase the production of young, and (3) reduce mortality rates. Reducing levels of long-lived pesticides in the environment, especially outside of the United States, will be difficult and will necessitate international cooperation. Artificial increase of fledging rates could be effected by manipulating eggs in nests in the wild or by manipulating young which have been bred in captivity. For example, first clutches from nests in the wild could be removed and artificially incubated and second clutches will be produced. Further, eggs or young can be placed into the nests of wild Peregrines. This was done successfully in Colorado in 1973 and

is perhaps the best technique as long as wild nesting pairs can be found. Peregrine eggs or young can be put in the nests of other species. It has been shown that hawks can successfully fledge Prairie Falcon young (R. Fyfe, pers. comm.). In some regions the Prairie Falcon would presumably be a suitable foster species, but possible adverse effects of "imprinting" by young Peregrines on their adult foster parents have not been determined. Young Peregrines can be released to the wild in the absence of adults by allowing them to fledge from a protected place and by supplying food until they are independent. This procedure has already been used successfully by H. Meng and by Cornell University in reintroducing captive-produced Peregrines in the eastern United States, avoiding the possibility of "imprinting," and can be used where no adult Peregrine pairs are present. The third means involves the techniques of falconry. Qualified falconers could take wild Peregrine nestlings, train them to hunt and release them after the first or second winter. Good falconers keep a higher percentage of young birds alive than occurs in the wild and perhaps twice as many could be released as would be expected to naturally survive (Cade 1974). Certainly there are many falconers capable of handling Peregrines successfully, but the scheme would require careful organization and so far there is little information relating to survival rates of trained falcons.

There is little doubt that rehabilitation of Peregrine populations south of Canada will consist mainly of the release of captive-bred birds produced by a few large breeding projects. Smaller projects have thus far served to provide reservoirs of the appropriate subspecies and have been useful in developing some of the necessary techniques. People proficient in falconry have clearly been crucial in the progress made in breeding falcons in captivity and are certain to be indispensable to further population rehabilitation efforts.

A major concern relates to the intentional or accidental release of exotic Peregrines in North America. One school contends only the form originally occurring in the area should be flown or released there. The other extreme contends that Peregrines are all substantially similar and that natural selection will determine the genetic attributes of any wild population, regardless of its origin. The argument is academic for the eastern United States since no captive stock of that former population exists and any Peregrines introduced there forming a viable population may well be better than no Peregrines at all. In the West, adequate captive stocks originating in the wild are being bred so that enzootic birds may be re-stocked. In any event, Peregrine populations in temperate North America will be to a major degree artificial in that they must be managed as long as DDE remains the dominant adversary.

Recent success of the Cornell program for captive breeding of Peregrines indicates that production of 250 young Peregrines per year from captive sources is possible by 1980. While some young produced will be retained for eventual captive breeding, many will be available for reintroduction. It is also likely that captive bred falcons will be eventually available to falconers. Since most of the present stock of breeding Peregrines in captivity was obtained on loan from falconers, it is logical for them to expect to receive some of the progeny. Regulation of the disbursement and final disposition of captively bred raptors will be a major problem until firm understandings supported by appropriate legislation are reached.

PERSPECTIVE

Interest in falconry is expected to increase at a slow rate because of more stringent regulations at the federal, state, and provincial levels and because of the difficulty in maintaining and training captive birds. No appreciable impact on wild populations of any species is anticipated because species or subspecies listed as endangered cannot be legally

used for falconry. Falconry will continue with the more common species such as Red-tailed Hawks and American Kestrels because other species are more difficult to acquire. Present official attitudes of most states and provinces surveyed reflect little apprehension that falconry is unmanageable or a drain on raptor populations. Some states and provinces believe that regulation of falconry is inordinately expensive in time and money because of demands of the few practitioners.

SUMMARY

The art of falconry in North America, practiced by a few individuals for many years, attracted little attention until the 1960's. Presently about 2800 falconers are licensed in the United States with less than one half considered to be active. While interest in this art is expected to increase, we believe growth will be slow, probably 5 to 10% per year, due to rigorous demands on time and equipment required and restrictive regulations.

Many different species of raptors have been used in falconry. Presently 6 species are commonly used, especially the Red-tailed Hawk and American Kestrel. Present evidence suggests that only 2 races of the Peregrine Falcon are threatened in North America, and declines may have occurred in local populations of other species. Declines in populations of Peregrines are attributed to pesticide contamination of food chains. Apparent declines in other populations of raptors are also attributed to pesticides and locally to changes in land use and possibly indiscriminate shooting. Removal of raptors from wild populations for falconry has not had documentable adverse effects except possibly at local nesting sites. Continuation of the art of falconry under the framework of the recent federal regulations is not expected to have measurable impacts on region-wide populations. Management of raptors is poorly developed and relatively unexplored. Captive breeding of raptors holds much promise for production of birds both for re-establishment and as a source of birds for falconry. Falconers have contributed much to the continued improvement of the Cornell University Peregrine program in terms of breeding stocks and technique development.

RECOMMENDATIONS

1. Additional data are urgently needed for the monitoring of changes in raptor populations over large areas. This may entail the development of new census techniques and establishment of national or continental surveys.
2. Falconry is a legitimate art and has a place in wildlife management and conservation. The art should not be popularized.
3. The federal falconry regulations should be adopted immediately by all states as they represent the initial step in uniform regulation of falconry and the taking of raptors. The Conservation Committee does not see the need for placing Great Horned Owls (*Bubo virginianus*) under the falconry statutes.
4. It is crucial that a practical banding or tattooing system for permanently identifying individual captive raptors be immediately established since enforcement of falconry regulations will be exceedingly difficult without it.
5. Any species of raptor bred in captivity, including properly accounted for and marked endangered species, should be allowed for falconry. The effect will be to encourage captive breeding and will reduce dependence on wild populations.
6. Properly accounted for and marked birds used in falconry should be allowed free interstate transport provided proper state and federal permits have been obtained.

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LITERATURE CITED

Anderson, D. W. and J. J. Hickey. 1972. Eggshell changes in certain North American birds. Proc. Int. Ornithol. Congr. 15:514–540.

Blood, D. A. 1968. Population status of Peregrine Falcons in the Queen Charlotte Islands, British Columbia. Can. Field-Nat. 82:169–176.

Braun, C. E., F. Hamerstrom, T. Ray, and C. M. White. 1975. Conservation committee report on status of eagles. Wilson Bull. 87:140–143.

Cade, T. J. 1968. The Gyrfalcon and falconry. Living Bird 7:237–240.

———. 1974. Plans for managing the survival of the Peregrine Falcon. Pp. 89–104, *in* Management of Raptors, Raptor Res. Found., Inc. Raptor Res. Rept. No. 2.

——— and R. Fyfe. 1970. The North American Peregrine survey, 1970. Can. Field-Nat. 83:191–200.

———, J. L. Lincer, C. M. White, D. G. Roseneau, and L. G. Swartz. 1971. DDE residues and eggshell changes in Alaskan falcons and hawks. Science 172:955–957.

Enderson, J. H. 1969. Prairie Falcon nesting success in Colorado in 1965. Pp. 362–363, *in* Peregrine Falcon populations: their biology and decline, (J. J. Hickey, ed.) Univ. Wisconsin Press, Madison.

——— and D. D. Berger. 1970. Pesticides: eggshell thinning and lowered production of young in Prairie Falcons. BioScience 20:355–356.

——— and G. Craig. 1974. Status of the Peregrine in the Rocky Mountains in 1973. Auk 91:727–736.

——— and P. H. Wrege. 1973. DDE residues and eggshell thickness in Prairie Falcons. J. Wildl. Manage. 37:476–478.

Fyfe, R. W. and R. R. Olendorff. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Can. Wildl. Serv., Occas. Pap. No. 23.

———, J. Campbell, B. Hayson, and K. Hodson. 1969. Regional population declines and organochlorine insecticides in Canadian Prairie Falcons. Can. Field-Nat. 83: 191–200.

Garber, P. G., J. R. Koplin, and J. R. Kahl. 1974. Osprey management on the Lassen National Forest, California. Pp. 119–122, *in* Management of Raptors, Raptor Res. Found., Inc., Raptor Res. Rept. No. 2.

Gates, J. M. 1972. Red-tailed Hawk populations and ecology in east-central Wisconsin. Wilson Bull. 84:421–433.

Hackman, C. D. and C. J. Henny. 1971. Hawk migration over White Marsh, Maryland. Chesapeake Sci. 12:137–141.

Harris, W. C. 1971. Red-tailed Hawk nesting success, 1971. Blue Jay 29:203.

Henny, C. J. 1972. An analysis of the population dynamics of selected avian species. U.S. Fish and Wildl. Serv., Res. Rep. 1.

——— and H. M. Wight. 1972. Population ecology and environmental pollution: Red-tailed and Cooper's Hawks. U.S. Fish and Wildl. Serv., Res. Rep. 2, pp. 229–250.

———, M. W. Nelson, and S. R Gray. 1976. Impact of 1974 DDT spraying for tussock moth control on American Kestrels. Unpublished Report submitted to U.S. Forest Service, Portland, OR (mimeo.) 23 pp. (A copy has been deposited in the van Tyne library.)

Hickey, J. J. (Editor). 1969. Peregrine Falcon populations; their biology and decline. Univ. Wisconsin Press, Madison.

——— and D. W. Anderson. 1968. Chlorinated hydrocarbons and eggshell changes in raptorial and fish-eating birds. Science 162:271–273.

Johnson, S. J. 1975. Productivity of the Red-tailed Hawk in southwestern Montana. Auk 92:732–736.

Kenward, R. E. 1974. Mortality and fate of trained birds of prey. J. Wildl. Manage. 38:751–756.

Leopold, A. 1933. Game management. Charles Scribner's Sons, New York.

Lincer, J. L. and J. A. Sherburne. 1974. Organochlorines in Kestrel prey: a north-south dichotomy. J. Wildl. Manage. 38:427–434.

Luttich, S. N., L. B. Keith, and J. D. Stephenson. 1971. Population dynamics of the Red-tailed Hawk (*Buteo jamaicensis*) at Rochester, Alberta. Auk 88:75–87.

Nelson, R. W. 1970. Langara Island, Queen Charlotte Islands. *In* the North American Peregrine survey, 1970, (T. Cade and R. Fyfe). Can. Field-Nat. 84:244–245.

Nye, A. G., Jr. 1966. Falconry. Pp. 164–173, *in* Birds in Our Lives, (A. Stefferud and A. L. Nelson, eds.) U.S. Dept. Interior, Bur. Sport Fish. and Wildl., Fish and Wildl. Serv.

Olendorff, R. R. and J. W. Stoddart. 1974. The potential for management of raptor populations in western grasslands. Pp. 47–88, *in* Management of Raptors. Raptor Res. Found., Inc., Raptor Res. Rept. No. 2.

Orians, G. and F. Kuhlman. 1956. Red-tailed Hawk and horned owl populations in Wisconsin. Condor 58:371–385.

Peakall, D. B. 1974. DDE: its presence in Peregrine eggs in 1948. Science 183:673–674.

Postupalsky, S. and S. M. Stackpole. 1974. Artificial nesting platforms for Ospreys in Michigan. Pp. 105–117, *in* Management of Raptors. Raptor Res. Found., Inc. Raptor Res. Rept. No. 2.

Ratcliffe, D. A. 1967. Decrease in eggshell weight in certain birds of prey. Nature 215:208–210.

Seidensticker, J. C., IV and H. V. Reynolds, III. 1971. The nesting, reproductive performance, and chlorinated hydrocarbon residues in the Red-tailed Hawk and Great Horned Owl in south-central Montana. Wilson Bull. 83:408–418.

Shor, W. 1970. Peregrine Falcon population dynamics deduced from band recovery data. Raptor Res. News 4:49–59.

Snyder, N. F., H. A. Snyder, J. L. Lincer, and R. T. Reynolds. 1973. Organochlorines, heavy metals, and the biology of North American Accipiters. BioScience 23:300–305.

Spofford, W. R. 1969. Hawk Mountain counts as population indices in northeastern America. Pp. 323–331, *in* Peregrine Falcon populations: their biology and decline, (J. J. Hickey, ed.) Univ. Wisconsin Press, Madison.

Stahlecker, D. W. and A. W. Alldredge. 1976. The impact of an underground nuclear fracturing experiment on cliff-nesting raptors. Wilson Bull. 88:151–154.

U.S. Department of the Interior. 1976. Environmental assessment: proposed falconry regulations. Fish and Wildlife Serv., Washington, D.C.

White, C. M. 1974. Current problems and techniques in raptor management and conservation. Trans. N. Am. Wildl. Nat. Resour. Conf. 39:301–312.

———, W. B. Emison, and F. S. L. Williamson. 1973. DDE in a resident Aleutian Island Peregrine population. Condor 75:306–311.

Wiley, J. W. 1975. The nesting and reproductive success of Red-tailed Hawks and Red-shouldered Hawks in Orange County, California, 1973. Condor 77:133–139.

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